EARTHQUAKE WEAKNESS

Natural Gas Safety

The Problem

Natural gas piping and appliances in homes can be damaged resulting in releases of natural gas that can lead to fires if ignition sources are present. Natural gas is typically a factor in about one out of four fire ignitions following earthquakes. However, the total number of earthquake-related fires, their sources and amounts of destruction can vary greatly depending upon a number of factors. Structural weaknesses or the absence of appliance anchors and flexible pipe connections lead to a greater possibility of gas leaks following earthquakes. Experience has shown that living in a seismically active area increases the risk of fire from all causes by a small amount. Since residential dwellings generally have several safe exit paths, the potential for life loss is limited. Therefore, the primary concern for homeowners is property loss from fire damage.

How to Identify It

Examine all natural gas appliances (water heaters, dryers, stoves, ovens, furnaces) to see if they are anchored to the floor or walls and have flexible pipe connections.

What Can Be Done

Relying on manual gas shutoff valves is an effective means to stop the flow of gas if persons are present after earthquakes. If you smell gas, hear gas escaping, or suspect a broken gas pipe, appliance, vent or flue, use a wrench to turn off the gas valve located at the gas meter. In addition, options such as earthquake actuated valves, excess flow valves, methane detectors, and hybrid systems can further reduce the risk of gas leaks and ignitions. However once the gas has been shutoff, service can only be restored by utility personnel or qualified plumbers. Demands for qualified personnel following earthquakes may lead to substantial delays in restoring service.

Homeowners should consider their specific circumstances and the suitability of these options. See Page 16 for the benefits and drawbacks of various options.

Figure 7—Manual Shutoff Valve Location

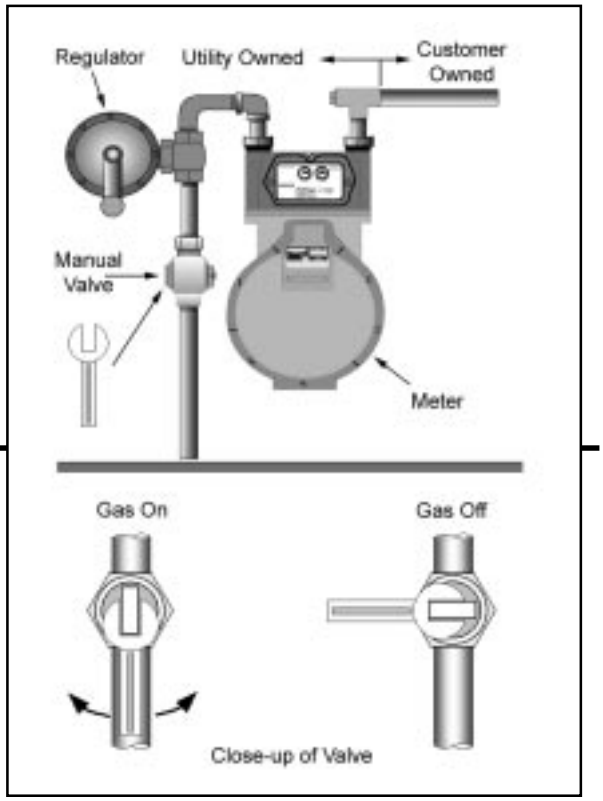

Table 1—Comparison of Costs: Preventing Vs Repairing Earthquake Damage

Earthquake Strengthening Project	*Cost of Project*	*Cost to Repair Unstrengthened House After Earthquake*	*See Page*
Bracing water heaters	$25 – 200	$200 – Total*	3
Anchoring foundations	250 – 5,000	25,000 – Total*	4
Bracing cripple walls	500 – 2,500	25,000 – Total*	5
Strengthening foundations	15,000 – 50,000	15,000 – Total*	6, 7
Bracing tall walls or posts	1,000 – 25,000	1,000 – Total*	8
Bracing garages with rooms above	200 – 25,000	1,000 – Total*	10
Bracing or replacing chimneys	2,000 – 12,000	1,000 – 15,000	11

*Total—full cost of home, which may be completely destroyed by this failure.

Building Permits

You will need a building permit for seismic retrofits whether you do the work yourself or hire a contractor. The *Guidelines for Seismic Retrofit of Existing Buildings,* Chapter 3 contains the current best guidelines for strengthening older homes to resist earthquake damage. Most municipal building departments will allow you to review a copy of this code at their plan-check counters.

Property Tax Exclusion

The state provides a property tax exclusion to encourage homeowners to undertake earthquake strengthening projects. If you make an addition such as a swimming pool or a new den to your home, your property tax bill will increase. But a strengthening project to help your home resist earthquakes will not add to your property taxes. You must file a claim form with your county assessor to receive the exclusion. The work must also be approved as appropriate seismic strengthening by your local building department.

Gas Shutoff Options

In addition to manual natural gas shutoff valves shown in figure 7 on page 12, several options are available to the public that can further reduce the risk of gas leaks and ignitions after earthquakes. The following tables describe Earthquake Actuated Valves, Excess Flow Valves, Methane Detectors, and Hybrid Systems and how they compare with each other and manual shutoff valves. Homeowners should consider their specific circumstances and suitability of these options for the customer-owned portion of the gas system. The information on page 16 can help homeowners reach their own conclusions on the benefits and drawbacks of various options. Earthquake Actuated Valves and Excess Flow Valves should be certified by the State Architect. Some installations will require building permits, so consult your local jurisdiction. Homeowners should be aware that some local jurisdictions have adopted ordinances requiring gas shutoff devices at time of sale or when significant renovations are undertaken.

Table 2: Gas Shutoff Option Costs

Device[1]	Hardware Cost	Installation Cost[2]
Restrain individual gas appliance	$15-$50	$0 - $100
Manual shutoff valve & wrench	$5-$20	$0
Earthquake actuated valve	$100 - $300	$100 - over $300 [3, 4, 5]
Excess flow valve at meter	$20 - $100	$100 - over $300 [3, 4]
Excess flow valve at appliance	$5 - $15	$0 - $100
Methane detector	$25 - $75	$0
Hybrid system	$150 - over $500[6]	$100 - over $500[7]

NOTES:

1. There are significant differences in the operation of the various devices listed.
2. All costs are approximate and do not include permit and inspections fees that may range from $25 to cover $100 depending upon the local jurisdiction. Installations that can be performed by the building owner are assumed to have no cost.
3. Installation costs do not include a survey of the gas system that can cost over $200.
4. Higher Installation costs may occur if substantial modifications of plumbing are necessary.
5. Higher installation costs may occur if substantial modifications to attach the valve to the building are necessary.
6. Costs for hybrid systems depend on the number and type of components installed.
7. Higher installation costs can be incurred for hybrid systems that require installation of wiring to connect multiple sensing units.

Table 3: Gas Shutoff Comparisons

Consideration	Manual Shutoff Valve and Wrench	Earthquake Actuated Valve	Excess Flow Valve	Methane Detector	Hybrid System
Basis of Operation	Utilities have installed manual shutoff valves near gas meters allowing owners with proper wrenches to shutoff gas in emergencies.	Senses shaking in a building that is above a design level of shaking and automatically shuts off gas.	Senses gas flows that are above a design shutoff flow rate and automatically shuts off gas	Senses the presence of natural gas in the air and triggers an alarm.	A variety of modular devices that could include a main control unit, shake sensors, excess flow sensors, methane detectors, valves, and alarms.
Benefits	All gas services already have valves installed. Guidance for occupants is currently provided in many public information documents like the phone book.	Actuates only in cases when building shaking may be sufficient to cause damage to the gas system. Someone does not need to be present to ensure shutoff.	Actuates only in cases when excess gas flows downstream of the device. Someone does not need to be present to ensure shutoff.	Alerts occupants when detectable gas concentrations are present before they reach hazardous levels, allowing time for shutoff and evacuation.	Systems are modular and can be customized for desired applications. Each module has benefits associated with specific action (e.g., motion sensing, flow sensing, methane detection).
Potential Drawbacks	Only effective if someone is present, knows the valve location, has access to the valve, and has a wrench suitable to close the valve.	Can actuate even if damage and hazards do not exist. Aftershocks can cause the device to actuate after service has been restored. May actuate from shaking not related to earthquakes.	Will not shut off gas if leakage is below the design shutoff flow rate, even if a slow leak exists. May not activate if the occupant changes gas systems downstream without modifying the device.	Someone needs to be present to respond to the alarm. Alarm may trigger for other flammable vapors in addition to natural gas.	Each module has drawbacks associated with specific actions (e.g., motion sensing, flow sensing, methane detection).